भारतीय मानक
Indian Standard

IS 6197 : 2019

1 600 मिमी व्यास तक के टेबुल वाली ऊर्ध्वाकार वेधन मिल एवं मिलिंग चक्की के लिये परीक्षण चार्ट

(पहला पुनरीक्षण)

Test Chart for Vertical Boring and Turning Mills with Table Diameter up to 1 600 mm

(First Revision)

ICS 25.080.10

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April 2019 **Price Group 5**

Machine Tools, Machine Tool Elements and Holding Devices Sectional Committee, PGD 35

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Machine Tools, Machine Tool Elements and Holding Devices Sectional Committee had been approved by the Production and General Engineering Division Council.

This standard was first published in 1971. The experience gained in implementation of the standard has necessitated this revision. In formulating this standard considerable assistance has been taken from ISO 3655 : 1986 'Acceptance conditions for vertical turning and boring lathes with one or two columns and a single fixed or movable table — General introduction and testing of the accuracy', issued by International Organization for Standardization.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant place retained in the rounded of value should be the same as that of the specified value in this standard.

Indian Standard

TEST CHART FOR VERTICAL BORING AND TURNING MILLS WITH TABLE DIAMETER UP TO 1 600 MM

(First Revision)

1 SCOPE

This standard describes both geometrical and practical tests on vertical boring and turning mills having single or double columns with table diameter up to 1 600 mm, and the corresponding permissible deviations, with reference to IS 2063 (Part 1).

It deals with the verification of accuracy and applies neither to the testing of the running of the machine (vibrations, abnormal noises, stick slip motion of components, etc) nor to the machine characteristics (speeds, feeds, etc) which shall generally be checked before testing the accuracy.

2 REFERENCES

The standards listed below contain provisions, which, through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on these standards are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
2063 (Part 1) : 2016	Test code for machine tools : Part 1 Geometric accuracy of machines operating under no-load or finishing conditions (*third revision*)
8000 (Part 1) : 1985	Geometrical tolerancing on technical drawings: Part 1 Tolerancing of form, orientation, location and run-out, and appropriate geometrical definitions (*first revision*)

3 PRELIMINARY REMARKS

3.1 To apply these tests, reference shall be made to IS 2063 (Part 1) especially for installation of the machine before testing, warming up of spindles and other moving parts, description of measuring methods and recommended accuracy of testing equipment.

3.2 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and does not define the practical order of testing. In order to make checking or mounting of instruments easier, tests may be run in quite different sequence.

3.3 When inspecting a machine, it is necessary to carry out all the tests described in this standard, excepting those tests, which may be omitted in mutual agreement between the buyer and the manufacturer.

3.4 All the tests described in this standard shall be carried out on parallel straightedge placed on two gauge blocks on table top. Straight edge surface shall be made square with axis of rotation of table to ensure correct level of top surface of straightedge.

3.5 The manufacturer shall determine the type and forms of tools, material of test piece, feed, depth of cut and table speed for conducting practical tests. It is, however, understood that the depth of cut and feed selected shall not generate appreciable cutting forces.

3.6 For the purpose of this standard, various methods of expressing permissible deviation are employed, each having a particular type of application. The methods employed are as follows:

a) 000/000 for deviations of perpendicularity which are ratios.

b) 000 for any length of 000 for deviations of straightness and parallelism, this expression is used to recommend a measuring length but in this case the proportionality rule comes into operation, if the measuring length differs from those indicated.

4 TESTING INSTRUMENTS

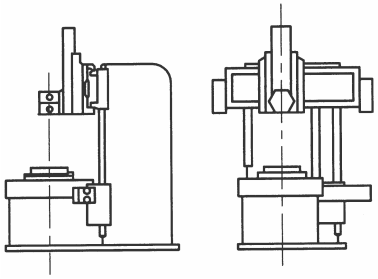
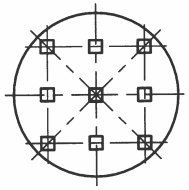
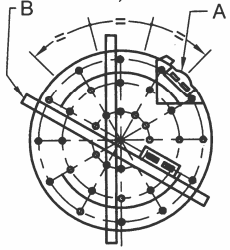
The testing instrument shall be of the approved type and shall be calibrated at a recognized temperature.

5 ACCURACY REQUIREMENTS

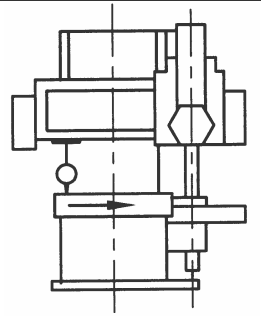
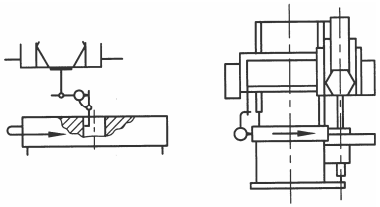
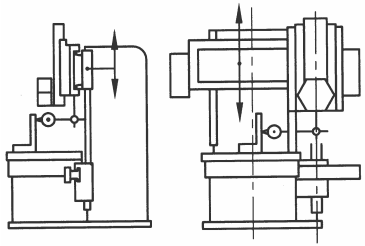
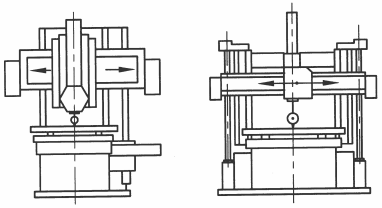
The tests to be carried out, the maximum permissible errors, the instruments required and the manner of carrying out the tests shall be as detailed in the test chart as given below:

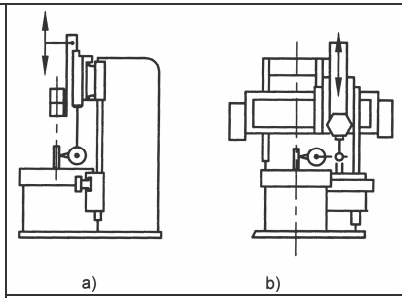
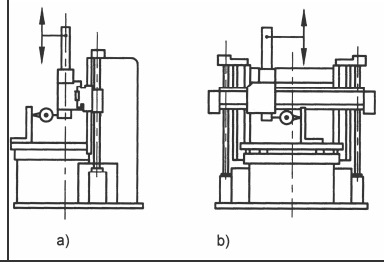
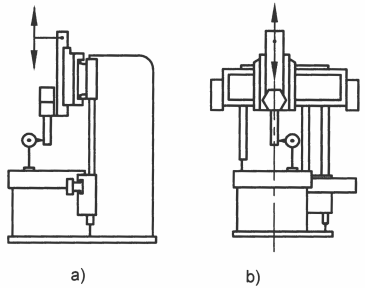
TEST CHART — ACCEPTANCE CONDITIONS AND PERMISSIBLE DEVIATIONS

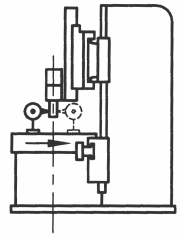
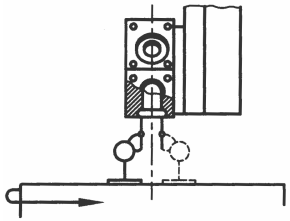
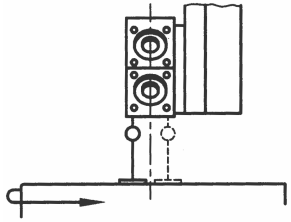
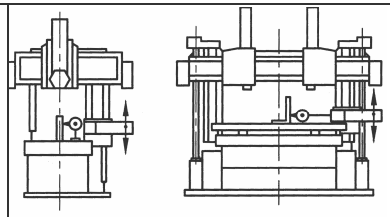
1 GEOMETRICAL TESTS

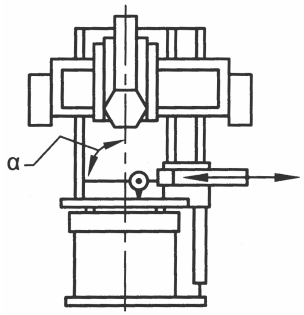
No.	Figure	Object	Permissible Deviation mm	Measuring Instruments	References to IS 2063 (Part 1) and Observations
		A — Table			
G0		Levelling	0.06/1 000	Straightedge and precision level	**6.1.2** NOTE — For table dimensions greater than 1 000 mm the number of positions for the level is to be agreed between the manufacturer and user.
G1	a)  ALTERNATIVE b) 

G1 | Verification of flatness of the table surface | 0.03 for any measuring diameter up to 1 000 flat to concave. Add 0.01 tolerance for each
1 000 mm increase in diameter.
Local tolerance 0.01
over any measuring length of 300 | Straightedge and gauge blocks or precision level | a) **12.2.3**
Alternative
b) **12.2.4**
Alternative test
(Checking with the aid of level)
1) Circular checking
The level shall be placed on a support '*A*' having three bearing points on the table periphery. The support shall be moved to positions equally spaced along the table periphery.
2) Radial checking
The level shall be placed on the table and along a diametrical direction with the aid of a straightedge '*B*'.
The level shall be moved at positions equally spaced along the straightedge.
The procedure shall be repeated moving the straightedge according to the successive positions occupied by the support '*A*'.
NOTE — Subject to agreement between manufacturer and user, it is permissible to carry out geometrical checking only. |

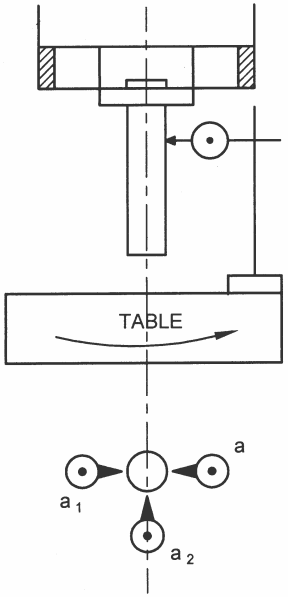
G2		Measurement of camming of the table when rotating.	0.02 for a table diameter of 1 000. Add 0.01 tolerance for each 1 000 mm increase in diameter.	Dial gauge	**9.1, 4** The dial gauge shall be placed on a fixed part of the machine and shall be placed as near as possible to the table periphery and approximately 180° from the position occupied by the tool when the table was machined. Rail, railhead and slide locked in position
G3		Measurement of run-out of the table bore or Measurement of run-out of the external cylinder surface of the table (in the case of a table not having a central bore.)	0.02 for a table diameter of 1 000. Add 0.01 tolerance for each 1 000 mm increase in table diameter.	Dial gauge	**12.5.1**, **12.5.2** The dial gauge shall be placed approximately 180° from the position occupied by the tool when the table was machined. Rail, railhead and slide locked in position. The dial gauge shall also be placed on a fixed part of the machine
	B — Rail and Railhead				
G4	a) b)  a) b)	Checking of squareness of the vertical slideways of the column to the table surface : a) in a plane perpendicular to the rail: b) in a place parallel to the rail.	a) 0.06 / 1 000 b) 0.04 / 1 000	Straightedge, square and dial gauge	**12.4.5** Railhead and slide locked in position. The rail shall be locked on its column or columns before each measurement. The checking shall be carried out moving the rail successively in the upper position, mid-travel, and in the lower position.
G5		Checking of the parallelism of the movement of railhead or railheads to the table surface.	a) 0.03 without a height correcting device for a 1 000 mm travel b) 0.02 with a height correcting device for a 1 000 mm travel	Straightedge, gauge blocks and dial gauge	**12.3.2.5.2** Rail and slide locked in position. Checking shall be made by applying the dial gauge stylus on a straightedge laid parallel to the table surface.

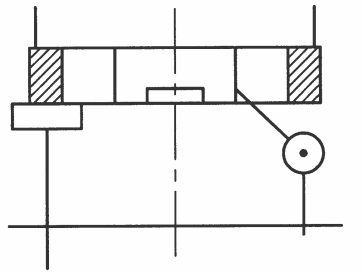
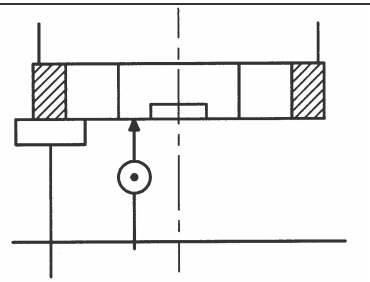
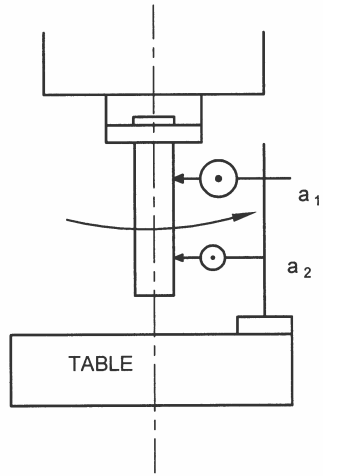
G6		Checking of parallelism of the toolhead slide or slides movement to the axis of the rotation of the table. a) In a plane perpendicular to the rail. b) In a plane parallel to the rail. or Checking of squareness of the toolhead slide or slides movement to the table surface a) In a plane perpendicular to the rail. b) In a plane parallel to the rail.	a) 0.015 b) 0.01 For a measuring length of 300	Test mandrel and dial gauge	**10.1.3** Rail and rail head locked in position.
				Straightedge square and dial gauge	**12.4.2** Rail and rail heads locked in position.
C — Turret					
G7		Checking of parallelism of the tools housing axes to the slide movement a) In a plane perpendicular to the rail. b) In a plane parallel to the rail	a) 0.03 b) 0.02 For a measuring length of: 300	Test mandrel and gauge	**12.3.2.4** These operations shall be repeated for each of the tool housings.

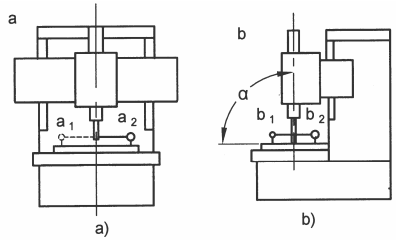
G8		Checking of co-axiality between the axes of tool housing and the axis of rotation of the table.	0.025* *The value of permissible deviation is equal to half of the readings of the dial gauge.	Test mandrel and dial gauge	**10.2, 12.3.4** A mandrel of a 300 mm maximum length shall be inserted in one of the tool housings. A dial gauge shall be fixed on the table; rotate the table and adjust the position of the mandrel until the deviations shown on the dial gauge are at a minimum. Repeat the operation by placing the dial gauge stylus at several different heights. Repeat the same operations for each of the tool housings.
G9		Checking of co-axiality between the axes of the centering surfaces of the tool holders and the axis of the rotation of the table.	0.025* *The value of permissible deviation is equal to half of the readings of the dial gauge.	Dial gauge	**10.2**, **12.3.4** A dial gauge shall be fixed on the table and shall touch the inside of the centering housing of the tool holders. The table shall be rotated. This same operation shall be repeated for each of the housings of the turret.
G10		Checking of squareness of the faces of turret with the axis of rotation of the table.	0.02/300	Dial gauge	**3.9.5**, **3.9.6** A dial gauge shall be fixed on the table and shall touch the face of turret located opposite. The table shall be rotated and dial gauge shall be moved to touch the face of turret on the largest possible diameter. This same operation shall be repeated for each of the faces of the turret.
D — Slide Head					
G11		Checking of parallelism of the side head movement to the axis of rotation of the table or Checking of the squareness of the side head movement to the table surface.	0.01 For a measuring length of 300. 0.01 For a measuring length of 300.	Test mandrel and dial gauge Straightedge, square and dial gauge	**10.1.3** **12.4.5** The square shall be placed on a straightedge parallel to the table surface.

G12		Checking of parallelism of the side head rail movement to the table surface.	0.02 For a measuring length of 300. Direction of deviation α > 90°.	Straightedge and dial gauge	**12.3.2.5.2** The side head shall be locked in position. Checking shall be carried out by placing the dial gauge stylus onto a straightedge laid parallel to the table surface.

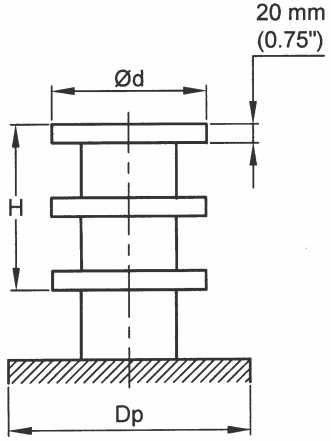
2 LIVE SPINDLE TESTS

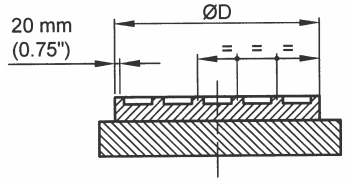
No.	Diagram	Object	Permissible Deviation in mm	Measuring Instruments	References to IS 2063 (Part 1) and Observations
		E — Tests for Machine with Live Spindle			
L1		Measurement of concentricity of center of live spindle to table center near the spindle nose.	a_1) 0.01 a_2) 0.03	Dial gauge and test mandrel	**10.2, 12.3.4** Position head on table center. Put measuring post with dial gauge on table. Apply measuring pin to test mandrel at a. Rotate table and read change in display off at a_1 and a_2.

L2		Measurement of concentricity of outer centering of spindle nose (For machines with outer centering).	0.01	Dial gauge	**10.2**, **12.3.4** Fix measuring post to spindle nose. Approach measuring pin of probing lever measuring device to centering. Rotate spindle and read display off.
L3		Measurement of axial run out of applying face of spindle nose.	0.02	Dial gauge	**9.1** Fix measuring post to Spindle nose. Approach measuring pin of dial gauge to biggest possible dia. of plane and face. Rotate spindle and read display off.
L4		Measurement of concentricity of inner taper of working spindle a_1) Near the spindle nose a_2) At a distance of 300 mm from spindle nose.	a_1) 0.01 a_2) 0.02	Dial gauge	**10** a_1) Insert test mandrel; put measuring post with dial on table. Apply measuring pin of dial gauge at a1 on test. a_2) Similar test of a1. Repeat at point a_2.

L5		Measurement of rectangularity of axis of working spindle to clamping face in a) Cross plane b) Longitudinal plane	a) 0.025 mm for 300 mm. (300 mm distance apart a_1 and a_2.) b) 0.025 for 300 mm $\alpha \leq 90°$. (300 mm distance apart b_1 and b_2.)	Straight edge, dial gauge and test mandrel	**3.9.5**, **3.9.6** Head in center position. Fix tilting arm with dial gauge on spindle (test mandrel) Approach measuring pin of dial gauge in cross plane at a_1 on to the straight edge and read change in display after tilting at a_2. Approach measuring pin of dial gauge in cross plane at b_1 on to the straight edge and read change in display after tilting at b_2.

3 PRACTICAL TESTS

No	Diagram	Nature of Test	Cutting Conditions	Checks to be Applied	Permissible Deviation		Measuring Instruments	References to IS 2063 (Part 1) and Observations
					Table diameter, Dp 1)	In mm		
P1	 H = 3/4 of the tool holder travel (Max = 1 000 mm) d = H/2 Material : cast iron	Machining on a cylinder of three bearing surfaces of a 20 mm maximum length.	With a tool mounted on a rail head.	Circularity [**14.3** of IS 8000 (Part 1) : 1985]	For Dp < 1 000 1 000 < Dp < 3 000 3 000 < Dp	0.005 0.01 0.015	Precision instruments	**B.1.1** and **B.1.2**
				Cylindricity [**14.4** of IS 8000 (Part 1) : 1985]	For H = 300	0.01		
P2			With a tool mounted on the side head (to be carried out only if there is sufficient ram travel.)	Circularity [**14.3** of IS 8000 (Part 1) : 1985]	For Dp < 1 000 1 000 < Dp < 3 000 3 000 < Dp	0.005 0.01 0.015		
				Cylindricity [**14.4** of IS 8000 (Part 1) : 1985]	For H = 300	0.01		

P3	 Table Dia Dp / D For Dp < 1 000 / 500 1 000 < Dp <3 000 / 1 000 3 000 < Dp / 1 500	Machining on a circular block of three concentric bends of 20 mm maximum width	With a tool mounted on rail head	Flatness [**14.2** of IS 8000 (Part 1) : 1985]	a) With a height correcting device: For Dp < 1 000 1 000 < Dp < 3 000 3 000 < Dp b) Without a height correcting device	0.01 0.02 0.03 0.02 0.03 0.04	Straightedge and gauge blocks or level	**B.1.1** and **B.1.2** The respective dimensioning of the three bands shall be determined in relation to the diameter of the test piece and shall be equally spaced.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Machine Tools, Machine Tool Elements and Holding Devices Sectional Committee, PGD 35

Organization	*Representative(s)*
Central Institute of Tool Design, Hyderabad	Shri Shujayat Khan (***Chairman***) Shri Uday Bhaskar Reddy (*Alternate*)
ACE Designers Limited, Bengaluru	Shri Benedict Machad Shri T. P. Sridhar (*Alternate*)
Advanced Machine Tool Testing Facility, Bengaluru	Shri Balaramaiah
Atlas Engineering Industries (P) Ltd, Batala	Shri Rajesh Kawatra Shri Deepak Kawatra (*Alternate*)
Bajaj Auto Limited, Pune	Shri D. D. Pawar Shri S. D. Gupta (*Alternate*)
Bharat Dynamics Limited, Hyderabad	Shri K. Vishweshwar Rao
Bharat Fritz Werner Limited, Bengaluru	Shri Ashok N. Badhe Shri Venkatesh R. Habib (*Alternate*)
Bharat Heavy Electricals Limited, Trichurapalli	Shri Royston D. Souza
Central Manufacturing Technology Institute, Bengaluru	Shri S. V. Mansur Shri P. Rajasekhar (*Alternate*)
Central Mechanical Engineering, Research Institute, Durgapur	Shri Amit Jyoti Banerjee Dr Nagahanumaian (*Alternate*)
Department of Heavy Industry, Ministry of Heavy Industries & Public Enterprises, New Delhi	Shri N. L. Goswami
Directorate General of Quality Assurance, New Delhi	Lt Col Dharmendra Singh Shri N. K. Bhadwya (*Alternate*)
Directorate General of Supplies and Disposals, New Delhi	Shri Mohanty Shri N. K. Upadhay (*Alternate*)
Directorate of Standardization, New Delhi	Lt Col Praveen Deo Shri V. K. Chhabra (*Alternate*)
Guindy Machine Tools Ltd, Chennai	Shri R Harikrishnan Shri R. Marimuthu (*Alternate*)
HMT Machine Tools Limited, Bengaluru	Shri N. Marudhachalam Shri T. Saidulu (*Alternate*)
Indian Machine Tools Manufacturers Association, Gurugram	Shri A. S. Pundle
ITI Limited, Bengaluru	Shri G Perumalsamy Shri D. V. Jayram (*Alternate*)
Jainson Mechanical Works, Ludhiana	Shri Satpall Jain Shri Jinender Jain (*Alternate*)
Kennametal India Ltd, Bengaluru	Shri Arvinda Shetty B. Shri Rajesh Ramesh Parave (*Alternate*)
Micromatic Grinding Technologies Ltd, Ghaziabad/Bengaluru	Shri R K Mahajan Shri Mahesh Samaria (*Alternate*)
Parisudh Machine Tools Pvt Limited, Ghaziabad	Shri V. S. Goindi Shri G. S. Goindi (*Alternate*)
Premier Limited, Pune	Shri S. D. Joshi Rajesh D Sharma (*Alternate*)
PSG College of Technology, Coimbatore	Dr B. Giriraj Dr P. V. Mohanram (*Alternate*)
Rites Limited, Gurugram	Shri Rajesh Aggarwal
Unison Clamping Devices Limited, Pune	Shri Pandurang Kallappa Sawant Shri Vikram Pandurang Sawant (*Alternate*)
BIS Directorate General	Shri A. Rengarajan, Scientist 'E' and Head (PGD) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri Kundan Giri
Scientist 'B' (PGD), BIS

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